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(19)

(54) IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF ROD OF METAL OR METAL ALLOY

(71) We, BICC LIMITED, a British Company, of 21 Bloomsbury Street, London WC1B 3QN, do hereby delcare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the manufacture of a rod or other elongate member of a metal or metal alloy, all such elongate metallic members hereinafter, for convenience, being included in the generic term "rod." The invention is especially, but not exclusively, concerned with a rolled rod of a metal or metal alloy that has been formed by a continuous casting process.

In the manufacture of copper rod by a continuous casting and rolling process, in some circumstances after normal descaling or pickling, the surface of the rod has small blemishes in the form of particles of copper oxide or of other foreign matter embedded in it and/or in the form of rolling defects such as laps (or folds), spills and fissures which, when the rod is drawn down into wire, may form weak portions in the wire and may even cause the wire to fracture or otherwise impair surface quality. With a view to reducing the risk that such blemishes will result in the formation of wire of an unacceptable standard, it has been proposed to remove such blemishes from the surface of a rod by passing the rod through a die of an appropriate size which shaves an external layer of copper from the rod and so removes the blemishes. This method of removing blemishes has three disadvantages. Firstly, a major proportion of the rod is scrapped by the formation of shavings by the shaving die; the depth of cut effected by the shaving die is dictated by the need to maintain concentricity of the die and this generally results in a depth of cut significantly larger than the depth of the blemishes. Secondly, the resultant shaved outer surface of the rod is so smooth that, when the rod is drawn down into wire, the smooth surface carries insufficient lubricant through the wire drawing die system with the result that enhanced wear of the dies of the system can occur. Thirdly, a shaving die of an appropriate size is required when shaving a particular rod and this die has to be replaced when, due to wear, it no longer removes a sufficient depth of copper from the surface of the rod.

It is an object of the present invention to provide an improved method of removing blemishes from the surface of a rod of metal or metal alloy which does not have the aforesaid disadvantages.

According to the invention, the improved method comprises grinding the outer surface of the rod throughout substantially the whole of its circumference by urging against said surface at least one grinding device comprising a multiplicity of metallic wires embedded in and protruding from an encapsulating body of substantially non-elastometic synthetic resinous material, and effecting relative rectilinear movement between the rod and said grinding device or devices in a direction substantially parallel to the axis of the rod and effecting relative rotational movement between the rod and said grinding device or devices about the rod axis, thereby to remove substantially all blemishes from said surface.

Preferably, the rod is caused to travel in the direction of its length and the or each grinding device is in the form of a wheel which is urged under pressure against the surface of and is rotatably driven bodily about the advancing rod and which is rotatably driven about its own axis. Preferably, also, the or each grinding wheel is arranged with its axis lying substantially parallel to the axis of the rod or, alternatively, to reduce wear of the circumferential surface of the wheel, the grinding wheel is arranged with its axis tangential to an imaginary cylinder of circular cross-section whose axis is that of

the rod, the wheel axis being skew to the axis of the rod and that part of the circumferential surface of the wheel in contact with the rod being substantially parallel to the axis of the rod. The or each grinding wheel of encapsulated wires is preferably rotatably driven about its own axis by separate drive means at a peripheral speed different from the linear speed of the rod.

Alternatively, the or each grinding wheel may be arranged with its axis tangential to an imaginary cylinder of circular cross-section whose axis is the axis of the advancing rod and lying in a plane at right angles to the axis of the rod and, in this case, the circumferential surface of the or each wheel is preferably shaped to bear against a proportion of the circumferential surface of the rod. For example, where two grinding wheels are provided on diametrically opposite sides of the rod, each wheel may have a groove of substantially semi-circular cross-section in its circumferential surface.

Preferably, the rod is caused to travel through two or more grinding stations at each of which two such grinding wheels are positioned on diametrically opposite sides of the rod.

The substantially non-elastomeric synthetic resinous material in which the multiplicity of wires of the or each grinding wheel or other grinding device are encapsulated and from which wires protrude preferably comprises an epoxy resin and it is preferable to use a resin that is slightly flexible for instance a cycloaliphatic epoxy resin. The resinous material in which the wires are encapsulated may incorporate a polyamide or other suitable plasticizer and/or talc or other suitable additive which serves as a lubricant. Preferably, the resinous material is hard enough to wear in a similar fashion to the wires but not so brittle as to break away in discrete lumps. The use of talc in the resinous material imparts some abrasion resistance and lubricity to the material.

The wires of the or each grinding wheel or other grinding device may be of any suitable hard metal or metal alloy, wire of stainless steel being preferred. Preferably, all or a major proportion of the wires extend substantially radially of the wheel and protrude from the resin in which they are encapsulated to a length lying in the range 40 to 500 μm; preferably, also, each wire has a diameter within the range 130 to 750 μm.

The invention also includes, for grinding the surface of a rod of metal or metal alloy, a grinding wheel or other grinding device as hereinbefore described.

The method and grinding device of the present invention provide three important advantages. Firstly, the grinding wheels of encapsulated wires form a roughened surface on the advancing rod and this roughened surface will carry sufficient lubricant through a die system, when the rod is drawn down into wire, to reduce substantially wear of the dies of the system. Secondly, the same grinding wheels can be employed with any rod of a diameter selected from a wide range of diameters by simple adjustment of the relative positions of the grinding wheels at each grinding station; furthermore the depth of metal removed from any rod can also be accurately determined. Thirdly, since it is no longer necessary to replace repeatedly shaving dies when they become worn and oversized, the method and grinding device of the present invention are substantially cheaper than the known method and shaving die hitherto employed.

The invention is further illustrated by a description, by way of example, of a preferred apparatus for and method of removing blemishes from the surface of a copper rod as the rod advances in the direction of its length, with reference to the accompanying diagrammatic drawings, in which:—

Figure 1 is a perspective view of an improved grinding wheel;

Figure 2 is a side elevation of preferred grinding apparatus; and

Figure 3 is an end view of the grinding apparatus shown in Figure 2.

Referring to Figure 1, the grinding wheel comprises a multiplicity of radially extending stainless steel wires encapsulated in and protruding from a body of cycloaliphatic epoxy resin containing a small proportion of talc. The grinding wheel is made by inserting a stainless steel wire brush of circular cross-section into a mould which has a central boss for forming the shaft hole and end faces that are slightly conical so that the density of wires in the vicinity of the circumferential surface of the wheel will be increased. The mould is filled with resin under vacuum to ensure that no cavities are formed in the resin when it sets and, after curing, the wheel is dressed to a smooth concentric surface by means of a conventional grinding wheel. The circumferential surface of the wheel may be profiled as desired.

After a small amount of preliminary running-in, resin at the surface of the wheel will erode away and leave short ends of wires protruding from the circumferential surface of the wheel, the lengths of these producing ends being such that they will cut the surface of an advancing rod but will not bend over and cause the surface of the rod to flow.

In removing blemishes from the surface of a copper rod using the grinding apparatus

shown in Figures 2 and 3, a rod 1 is drawn by take-off means (not shown) through a stationary tube 2 which is mounted in a bearing 3 and held by a fixed support 4. Grinding wheels 5, as shown in Figure 1, are mounted in bearings on shaped plates 6 pivoted at points 15 on an annular disc 8 which is mounted by spacers (not shown) from a main disc 9. The main disc 9 is fixed to a hollow shaft 10 which is rotatably mounted in a fixed housing 11. The shaft 10 is driven via a pulley 12 by a belt from a driving motor (not shown). Fixed to the stationary housing 11 is a toothed-belt pulley 13. Shafts 14 are mounted in bearings in the main disc 9 and are co-linear with the pivots 15. Belts 16, 17 connect shafts 14 to the fixed pulley 13. Further belts 18, 19 connect shafts 14 to pulleys on the shafts of the grinding wheels 5.

The belts 16, 17, 18 and 19 are arranged to give a progressive gearing up so that when shaft 10 rotates at 500 rpm the grinding wheels will rotate at about 4000 rpm.

The rod 1 is held concentric with respect to the stationary tube 2 by a guide 20 and further guides 21 (Figure 3) in the plane of the grinding wheels 5. The guides 20 and 21 are supported by the main disc 9.

When the grinding apparatus is stationary, springs 22 cause shaped plates 6 to pivot to lift the grinding wheels 5 away from the rod 1. When the grinding apparatus is started, centrifugal force acting on the plates 6 will cause the grinding wheels 5 to come into contact with the rod 1 and will cause the plates 6 to bear against adjusting screws 23 by which the cutting depth of the wheels can be regulated.

Coolant is supplied to the grinding apparatus by nozzles 24. The whole grinding apparatus is enclosed in a shroud 25.

WHAT WE CLAIM IS:—

1. A method of removing blemishes from the surface of a rod of metal or metal alloy which comprises grinding the outer surface of the rod throughout substantially the whole of its circumference by urging against said surface at least one grinding device comprising a multiplicity of metallic wires embedded in and protruding from an encapsulating body of substantially non-elastomeric synthetic resinous material, and effecting relative rectilinear movement between the rod and said grinding device or devices in a direction substantially parallel to the axis of the rod and effecting relative rotational movement between the rod and said grinding device or devices about the rod axis, thereby to remove substantially all blemishes from said surface.

2. A method of removing blemishes from the surface of a rod of metal or metal alloy which comprises causing the rod to travel in the direction of its length and grinding the outer surface of the rod throughout substantially the whole of its circumference by urging against said surface at least one grinding wheel comprising a multiplicity of metallic wires embedded in and protruding from an encapsulating body of substantially non-elastomeric synthetic resinous material, which wheel or each of which wheels is rotatably driven bodily about the advancing rod and is rotatably driven about its own axis, thereby to remove substantially all blemishes from said surface.

3. A method as claimed in Claim 1, wherein the or each grinding device is a wheel rotatably driven about its axis.

4. A method as claimed in Claim 2 or 3, wherein the or each grinding wheel is arranged with its axis lying substantially parallel to the axis of the rod.

5. A method as claimed in Claim 2 or 3, wherein the or each grinding wheel is arranged with its axis tangential to an imaginary cylinder of circular cross-section whose axis is that of the rod, the wheel axis being skew to the axis of the rod and that part of the circumferential surfuce of the wheel in contact with the rod being substantially parallel to the axis of the rod.

6. A method as claimed in Claim 2 or 3, wherein the or each grinding wheel is arranged with its axis tangential to an imaginary cylinder of circular cross-section whose axis is that of the rod and lying in a plane at right angles to the axis of the rod.

7. A method as claimed in Claim 6, wherein the circumferential surface of the or each wheel is shaped to bear against a proportion of the circumferential surface of the rod.

8. A method as claimed in Claim 7 in which two grinding wheels are positioned on diametrically opposite sides of the rod, each wheel having a groove of substantially semi-circular cross-section in its circumferential surface.

9. A method as claimed in any one of Claims 2 to 5, wherein two grinding wheels are positioned on diametrically opposite sides of the rod.

10. A method as claimed in Claim 8 or 9, wherein the rod is caused to travel through two or more grinding stations at each of which two such grinding wheels are positioned on diametrically opposite sides of the rod.

11. A method as claimed in any one of the preceding claims, wherein the non-elastomeric synthetic resinous material of the or each grinding wheel or other device comprises an epoxy resin.

12. A method as claimed in any one of the preceding claims, wherein the non-elastomeric synthetic resinous material the or each grinding wheel or other device

incorporates talc or other additive which serves as a lubricant.

13. A method is claimed in any one of the preceding claims, wherein the rod is of copper.

14. For use in the method claimed in any one of the preceding claims, a grinding wheel or other grinding device comprising a multiplicity of metallic wires embedded in and protruding from an encapsulating body of substantially non-elastomeric synthetic resinous material.

15. A grinding wheel as claimed in Claim 14, wherein the or a major proportion of the encapsulated wires extend substantially radially of the wheel and protrude from its circumferential surface.

16. A grinding wheel or other grinding device as claimed in Claim 14 or 15 wherein the wires protrude to a length lying in the range 40 to 500 μm.

17. A grinding wheel or other grinding device as claimed in any one of Claims 14 to 16, wherein each wire has a diameter within the range 130 to 750 μm.

18. A grinding wheel or other grinding device as claimed in any one of Claims 14 to 17, wherein the wires are of stainless steel.

19. A grinding wheel or other grinding device as claimed in any one of Claims 14 to 18, wherein the resinous material is a cycloaliphatic epoxy resin or other epoxy resin.

20. A grinding wheel or other grinding device as claimed in any one of Claims 14 to 19, wherein the resinous material incorporates talc or other additive serving as a lubricant.

21. A grinding wheel or other grinding device as claimed in any one of Claims 14 to 20, wherein the resinous material incorporates a polyamide or other plasticizer.

22. A grinding wheel substantially as hereinbefore described with reference to and as shown in Figure 1 of the accompanying drawings.

23. Apparatus for removing blemishes from the surface of a rod of metal or metal alloy comprising at least one grinding wheel or other grinding device as claimed in any one of Claims 14 to 22 and means for urging said grinding wheel or device against the outer surface of a rod.

24. Apparatus for removing blemishes from the surface of a rod of metal or metal alloy substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

25. A method of removing blemishes from the surface of a copper rod substantially as hereinbefore described with reference to the accompany drawings.

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1546159 COMPLETE SPECIFICATION

1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig.1.

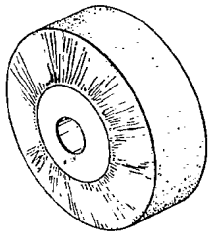

Fig.2.

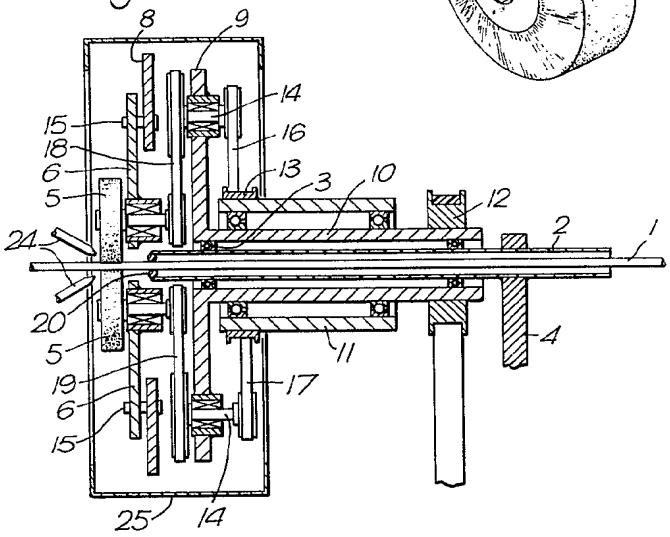

Fig.3.